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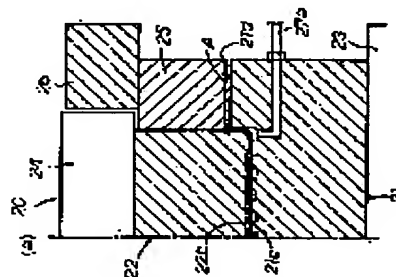
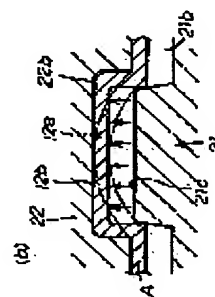
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(54) THIN METAL PLATE HAVING MANY PROJECTIONS ON SURFACE AND ITS MANUFACTURING METHOD

(57)Abstract:

PROBLEM TO BE SOLVED: To manufacture a thin metal plate having many projections by compression-formed without causing creak, warp, droop to a shoulder part and a base part of the projecting part.

SOLUTION: In the thin metal plate having many projections 12 on the surface, a forming material A is held between a female die 22 having many recessedious 22b on the surface and a male die 21 having many projections on to the bottom part of a recessed part 21 where the female die 22 is inserted, in the state that a liquid pressure is actuated between the forming material A and the recessed part 21b of the male die 21, the forming material A is formed stepwise by conducting compressed-forming.



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CLAIMS

[Claim(s)]

[Claim 1] It is the light-gage metal plate which has much heights on the front face characterized by being the light-gage metal plate which has much heights on a front face, and for the aforementioned heights pinching a light-gage metal plate between the female which has many crevices on a front face, and the male which has much heights at the pars basilaris ossis occipitalis of the hollow section in which this female is inserted, and being pressed and formed in the state where the fluid pressure was made to intervene between the hollow sections of this light-gage metal plate and the aforementioned male.

[Claim 2] It is the light-gage metal plate which has much heights in a light-gage metal plate according to claim 1 on the front face on which the thickness of a metal plate is 0.5mm or less, and each aforementioned heights are characterized by 2-3mm and height being [0.4-0.6mm and a pitch interval] 2-5mm for a diameter.

[Claim 3] How to manufacture the light-gage metal plate which is characterized by providing the following and which has much heights on a front face according to claim 1 or 2. Are the manufacture method pressed and manufactured between the males which have much heights at the pars basilaris ossis occipitalis of the hollow section by which the female which has many crevices, and this female are inserted in a front face, and while adopting the aforementioned male as female mold, the aforementioned female is adopted as a punch. The 1st process which lays a light-gage metal plate in the upper-limit section of this female mold so that air may not go into the hollow section of the aforementioned female mold which is a male, where a liquid is filled. The 2nd process which pinches the marginal part of the light-gage metal plate which the blank holder located in the periphery of the aforementioned punch which is a female was dropped, and was laid in the aforementioned female mold with the upper-limit marginal part of this female mold. The 3rd process which descends the aforementioned punch relatively to the aforementioned female mold where the hollow section of the aforementioned female mold and the fluid pressure between the aforementioned light-gage metal plates are maintained to high pressure, and is inserted in the hollow section of the aforementioned female mold from a bottom dead point to specified quantity this side. They are much heights to the front face characterized by having the 4th process which descends the aforementioned punch still more relatively where the hollow section of the aforementioned female mold and the fluid pressure between the aforementioned light-gage metal plates are extracted, and is inserted in the hollow section of the aforementioned female mold to near the bottom dead point.

[Claim 4] The manufacture method of a light-gage metal plate of having much heights on the front face characterized by inserting the aforementioned punch in the hollow section of the aforementioned female mold from a bottom dead point to about 1mm of this side at the 3rd process of the above, and inserting the aforementioned punch in the hollow section of the aforementioned female mold from a bottom dead point to about 0.5mm of this side at the 4th process of the above in the manufacture method according to claim 3.

[Claim 5] How to manufacture the light-gage metal plate which is characterized by providing the following and which has much heights on a front face according to claim 1 or 2. The 1st process which is the manufacture method pressed and manufactured between the males which have

much heights at the bottom of the hollow section by which the female which has many crevices, and this female are inserted in a front face, adopts the aforementioned female as female mold while adopting the aforementioned male as a punch, and lays a light-gage metal plate in the upper-limit section of the aforementioned female mold which is a female. The 2nd process with which a liquid is filled so that air may not enter between the hollow section of the aforementioned punch, and the aforementioned light-gage metal plate, while pinching the marginal part of the light-gage metal plate which the blank holder located in the periphery of the aforementioned punch which is a male was dropped, and was laid in the aforementioned female mold at the upper-limit marginal part of this female mold. The 3rd process which goes up the aforementioned female mold relatively to the aforementioned punch where the hollow section of the aforementioned punch and the fluid pressure between the aforementioned light-gage metal plates are maintained to high pressure, and is inserted in the hollow section of the aforementioned punch from a top dead center to specified quantity this side. They are much heights to the front face characterized by having the 4th process which goes up the aforementioned female mold still more relatively where the hollow section of the aforementioned punch and the fluid pressure between the aforementioned light-gage metal plates are extracted, and is inserted in the hollow section of the aforementioned punch to near the top dead center.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[The technical field to which invention belongs] this invention relates to the light-gage metal plate which has much heights on a front face, and its manufacture method.

[0002]

[Description of the Prior Art] The thickness of a metal plate of the light-gage metal plate which has much heights on a front face is very as thin as 0.5mm or less, and, as for each heights, a diameter is formed by 2-3mm and height being [0.4-0.6mm and a pitch interval] 2-5mm, and pinching among vertical both the molds that consist the steel plate of thin meat, a stainless steel board, an aluminum board, a copper plate, etc. of a male and a female, and pressing. In compression molding, the minimum spacing between both **** at the time of both molds closing (bottom dead point) is set up so that a light-gage metal plate may become equal thickly. Such a light-gage metal plate is formed with a half-blanking press-working-of-sheet-metal means as shown in JP,11-167927,A.

[0003]

[Problem(s) to be Solved by the Invention] By the way, in the light-gage metal plate concerned, when based on the above-mentioned compression-molding means, it is not easy to originate thickly, to be easy to generate a crack, and for the whole board to curve with the reaction force after fabrication, or to be easy to generate whom in the shoulder and base of each heights, and to fabricate the set-up exact, very thin product with the sufficient yield. Moreover, when based on the above-mentioned half-blanking press-working-of-sheet-metal means, the mold structure to be used cannot but become complicated. Therefore, the purpose of this invention is to cope with this problem.

[0004]

[Means for Solving the Problem] The light-gage metal plate which this invention requires for this invention about the light-gage metal plate which has much heights on a front face, and its manufacture method is a light-gage metal plate which has much heights on a front face. the aforementioned heights It is characterized by pinching a light-gage metal plate between the males which have much heights at the pars basilaris ossis occipitalis of the hollow section by which the female which has many crevices, and this female are inserted in a front face, and being formed by pressing in the state where the fluid pressure was made to intervene between the hollow sections of this light-gage metal plate and the aforementioned male.

[0005] In the light-gage metal plate concerning this invention, the thickness of a metal plate is 0.5mm or less, and the diameter of each aforementioned heights can be set to 2-3mm, and it can set 0.4-0.6mm and a pitch interval to 2-5mm for height.

[0006] Moreover, the manufacture method concerning this invention is a method of manufacturing the light-gage metal plate concerning this invention, and is the manufacture method pressed and manufactured between the males which have much heights at the pars basilaris ossis occipitalis of the hollow section in which the female which has many crevices on a front face, and this female are inserted.

[0007] Carry out a deer, and the aforementioned female is used for it as a punch while the 1st

manufacture method concerning this invention adopts the aforementioned male as female mold. The 1st process which lays a light-gage metal plate in the upper-limit section of this female mold so that air may not go into the hollow section of the aforementioned female mold which is a male, where a liquid is filled, The 2nd process which pinches the marginal part of the light-gage metal plate which the blank holder located in the periphery of the aforementioned punch which is a female was dropped, and was laid in the aforementioned female mold with the marginal part of the upper-limit section of this female mold, The 3rd process which descends the aforementioned punch relatively to the aforementioned female mold where the hollow section of the aforementioned female mold and the fluid pressure between the aforementioned light-gage metal plates are maintained to high pressure, and is inserted in the hollow section of the aforementioned female mold from a bottom dead point to specified quantity this side, It is characterized by having the 4th process which descends the aforementioned punch still more relatively where the hollow section of the aforementioned female mold and the fluid pressure between the aforementioned light-gage metal plates are extracted, and is inserted in the hollow section of the aforementioned female mold to near the bottom dead point.

[0008] In the manufacture method concerned, at the 3rd process of the above, the aforementioned punch can be inserted in the aforementioned female mold from a bottom dead point to about 1mm of this side, and it can consider as the mode which inserts the aforementioned punch in the aforementioned female mold from a bottom dead point to about 0.5mm of this side by the 4th process of the above.

[0009] Moreover, the aforementioned female is used for it as female mold while the 2nd manufacture method concerning this invention adopts the aforementioned male as a punch. The 1st process which lays a light-gage metal plate in the upper-limit section of the aforementioned female mold which is a female, The 2nd process with which a liquid is filled so that air may not enter between the hollow section of the aforementioned punch, and the aforementioned light-gage metal plate while pinching the marginal part of the light-gage metal plate which the blank holder located in the periphery of the aforementioned punch which is a male was dropped, and was laid in the aforementioned female mold at the marginal part of the upper-limit section of this female mold, The 3rd process which goes up the aforementioned female mold relatively to the aforementioned punch where the hollow section of the aforementioned punch and the fluid pressure between the aforementioned light-gage metal plates are maintained to high pressure, and is inserted in the hollow section of the aforementioned punch from a top dead center to specified quantity this side, It is characterized by having the 4th process which goes up the aforementioned female mold still more relatively where the hollow section of the aforementioned punch and the fluid pressure between the aforementioned light-gage metal plates are extracted, and is inserted in the hollow section of the aforementioned punch to near the top dead center.

[0010] In the manufacture method concerned, at the 3rd process of the above, the aforementioned female mold can be inserted in the hollow section of the aforementioned punch from a top dead center to about 1mm of this side, and it can consider as the mode which inserts the aforementioned female mold in the hollow section of the aforementioned punch from a top dead center to about 0.5mm of this side by the 4th process of the above.

[0011]

[Function and Effect of the Invention] The light-gage metal plate which has the heights of a large number concerning this invention pinches a light-gage metal plate between the males which have much heights at the pars basilaris ossis occipitalis of the hollow section by which the female which has many crevices, and this female are inserted in a front face, and is formed by pressing in the state where the fluid pressure was made to intervene between the hollow sections of this light-gage metal plate and the aforementioned male.

[0012] For this reason, in compression molding of a light-gage metal plate, before both **** of both molds reach minimum spacing (bottom dead point), much heights can be gradually fabricated on two or more step story, and whose generating [in / curvature, and the shoulder or base of each heights / it is divided and] resulting from compression molding which closes **** of both molds to minimum spacing (bottom dead point) to ***** can be canceled. Moreover, as compared with the case where a half-blanking press-working-of-sheet-metal means is taken,

mold structure is easy to be the thing of easy structure.

[0013] The light-gage metal plate which has the heights of a large number concerning this invention breaks, and can be suitably adopted as separator which is an exact product as [which does not have whom in curvature, and the shoulder or base of each heights] set up, for example, constitutes the fuel cell which makes fuel gas and oxidizer gas reactant gas. Since this separator does not have whom in the shoulder or base of each heights not to mention a lightweight thing, it has the big advantage that a touch area with the electrode which constitutes a fuel cell, and the cross section of a gas passageway are widely securable. Such a light-gage metal plate can be easily manufactured efficiently by the 1st and 2nd manufacture method concerning this invention.

[0014]

[Embodiments of the Invention] Hereafter, this invention is explained with reference to a drawing. Drawing 1 - drawing 5 show each process of the 1st manufacture method which manufactures the light-gage metal plate which has much heights on the front face concerning an example of this invention, and the light-gage metal plate 10 shown in drawing 5 is manufactured by the manufacture method concerned.

[0015] The light-gage metal plate 10 concerned has much heights 12 on the front face of the main part 11 of a metal plate, the thickness of the main part 11 of a metal plate is 0.5mm or less, and the pitch interval of each heights 12 is [diameters are / 2-3mm and height / the things of the shape of a pillar which is 0.4-0.6mm, and] 2-5mm. Moreover, each heights 12 are presenting the shape of a taper slightly extended toward the end face section from the point. Although the light-gage metal plate 10 concerned has the property which has neither a crack nor curvature and does not have whom in the shoulder or base of each heights 12 and makes stainless steel (SUS316L) the molding material, otherwise, it can make a molding material other steel plates (SCP, SHP), an aluminum board, a copper plate, etc.

[0016] The 1st press-forming machine 20 shown in drawing 1 - drawing 5 is used for the light-gage metal plate 10 concerned, and it is manufactured through the 1st process - the 5th process. The manufacture method of having these processes is the 1st manufacture method concerning this invention, the press-forming machine 20 is equipped with the punch 22 which is the female mold 21 and the female which are a male, and female mold 21 is attached on the press head 23, and the punch 22 is attached in the inferior surface of tongue of the inner slider 24. Moreover, the press-forming machine 20 concerned equips the periphery of the inner slider 24 with the outer slider 26 while equipping the periphery of a punch 22 with a blank holder 25. The outer slider 26 is constituted possible [rise and fall], and functions that it should go up and down a blank holder 25. Moreover, the inner slider 24 is constituted possible [rise and fall], and functions that it should go up and down a punch 22.

[0017] Female mold 21 equipped the center section of main part of mold 21a with hollow section 21b which carries out opening to the upper part, and equips the pars basilaris ossis occipitalis of hollow section 21b with much heights 21c. The fluid-pressure developmental mechanics 27 is connected with female mold 21, and fluid-pressure introduction duct 27a is carrying out opening at the pars basilaris ossis occipitalis of hollow section 21b of female mold 21. In female mold 21, while hollow section 21b is formed in the size which a punch 22 can insert exactly, 21d of upper-limit marginal parts is located so that a blank holder 25 may counter. 21d of upper-limit marginal parts is constituted so that the stainless steel board A of the thin meat which is the molding material of the light-gage metal plate 10 can lay in the upper surface. The punch 22 equips main part of mold 22a with much crevice 22b on the inferior surface of tongue, and insertion of it is attained by downward operation of the inner slider 24 at hollow section 21b of female mold 21. Each crevice 22b of a punch 22 has countered each heights 21c of female mold 21.

[0018] In the manufacture method concerned, the stainless steel board (SUS316L) A with a thickness of 0.2mm is adopted as a molding material of the light-gage metal plate 10, and it considers as the object of manufacture of the light-gage metal plate which has the heights of a large number with the outer diameter of 2.3mm, a height [of 0.5mm], and a pitch interval of 2.6-3.0mm, and is manufactured through the 5th process shown in drawing 5 from the 1st process shown in drawing 1 .

[0019] It supplies liquids, such as an oil, to hollow section 21b of female mold 21 from the fluid-pressure developmental mechanics 27, the manufacture method of having these processes is the 1st manufacture method concerning this invention, it fills them with the 1st process shown in drawing 1 until an oil level arrives at 21d of upper-limit marginal parts of female mold 21, and it lays the stainless steel board A in 21d of upper-limit marginal parts of the female mold 21 of this state. In this case, while making it air not enter between the oil level of the liquid which were full of, and the stainless steel board A, it is important in a liquid to make it air not mix as a foam, and, for this reason, it is desirable to apply a liquid to the rear face of the stainless steel board A beforehand.

[0020] At the 2nd process shown in drawing 2, the blank holder 25 which descends the outer slider 25 and is located in the periphery of a punch 22 is dropped, and the marginal part of the stainless steel board A laid in female mold 21 is pinched with 21d of upper-limit sections of female mold 21. The compression pressures to the stainless steel board A in this time are about 140 kgf/cm².

[0021] At the 3rd process shown in drawing 3, where the fluid pressure between hollow section 21b of female mold 21 and the stainless steel board A is maintained to high pressure, the inner slider 24 is descended, a punch 22 is dropped, and a punch 22 is inserted in hollow section 21b of female mold 21 from a bottom dead point to specified quantity this side. The fluid pressure in this case is maintained to about two 2000 kgf/cm by the fluid-pressure developmental mechanics 27. Moreover, the time of saying the time of a punch 22 descending completely, and heights 21c of female mold 21 and the interval between crevice 22b of a punch 22 (both mold spacing) reaching the amount (0.2mm) of thickness of the stainless steel board A by the manufacture method concerned, as for a bottom dead point is said. As for the insertion to hollow section 21b of female mold 21, it is desirable that both the mold spacing is about 1.2mm about the punch 22 in this time. Thereby, much heights 12a shown in this drawing (b) is fabricated by the stainless steel board A which is a molding material.

[0022] At the 4th process shown in drawing 4, where the fluid pressure between hollow section 21b of female mold 21 and the stainless steel board A is extracted, the inner slider 24 is descended, a punch 22 is dropped, and a punch 22 is inserted in hollow section 21b of female mold 21 to near the bottom dead point. As for the insertion to hollow section 21b of the female mold 21 of the punch 22 in this time, it is desirable that the interval between both **** is about 0.5mm. Although the fluid pressure in this case is about 0, the stainless steel board A which is a molding material is pressed by both the molds 21 and 22 after the liquid has intervened among crevice 22b of heights 21c of female mold 21, and a punch 22, and, thereby, much heights 12b shown in this drawing (b) is fabricated by the stainless steel board A which is a molding material. Heights 12b is the thing of the configuration which heights 12a shown in (b) of drawing 3 was again pressed, and approximates to each heights 12 of the light-gage metal plate 10 extremely.

[0023] At the 5th process shown in drawing 5, where the liquid between hollow section 21b of female mold 21 and the stainless steel board A is drained, the inner slider 24 is descended, a punch 22 is dropped, and a punch 22 is inserted in hollow section 21b of female mold 21 to a bottom dead point. Heights 12b currently formed in the stainless steel board A which is a molding material by this is pressed again, and deforms into the heights 12 shown in this drawing (b). That is, much heights 12 are formed in the stainless steel board A which is a molding material, and the light-gage metal plate 12 is completed.

[0024] In the manufacture method concerned, although the stainless steel board A which is a molding material is pressed using both the molds 21 and 22 From it being what a fluid pressure is made to intervene and is pressed between **** of both the molds 21 and 22, further Since it presses gradually between **** of both the molds 21 and 22 where a fluid pressure is changed, whose generating in a crack, curvature, and the shoulder and base of each heights can be prevented. That is, according to the manufacture method concerned, the light-gage metal plate 10 can be manufactured without making the stainless steel board A which is a molding material produce a crack and curvature, and the shoulder or base of each heights 12 are not produced for whom in this case.

[0025] About each separator 13 and 14, 2nd press machine 20A shown in drawing 6 – drawing 10

can be used, and it can also manufacture through the 1st process – the 5th process. It is the 1st manufacture method which the manufacture method of having these processes also requires for this invention, and only the female mold 28 whose press-forming machine 20A is a male structurally is different in the female mold 21 of the 1st press machine 20. Female mold 28 is equipped with female mold die 28a and ejector-half 28b. Ejector-half 28b is equipped with much pillar-shaped section 28c, fitted into the breakthrough possible [sliding] from the pars basilaris ossis occipitalis of female mold die 28a, and the pars basilaris ossis occipitalis whose crowning of each pillar-shaped section 28c is 28d of hollow sections of female mold die 28a is faced it. By the operation of oil hydraulic cylinder 28e, to female mold die 28a, specified quantity rise and fall are possible for ejector-half 28b, and it carries out a specified quantity protrusion from the pars basilaris ossis occipitalis whose crowning of each pillar-shaped section 28c is 28d of hollow sections of female mold die 28a at the time of elevation, and functions as each heights 21c of the female mold 21 which constitutes the 1st press machine 20 similarly.

[0026] The female mold 28 shown in drawing 9 and drawing 10 shows the state where ejector-half 28b carried out specified quantity elevation, and carried out the specified quantity protrusion of the crowning of each pillar-shaped section 28c from the pars basilaris ossis occipitalis of 28d of hollow sections of female mold die 28a, and each pillar-shaped section 28c is in this state, and it functions as each heights 21c of the female mold 21 which constitutes the 1st press machine 20 similarly. Although a bottom dead point means the time of a punch 22 descending completely in the manufacture method concerned, the time of the upper-limit side of the crowning in the state where the specified quantity protrusion was carried out from the pars basilaris ossis occipitalis whose crowning of each pillar-shaped section 28c of female mold 28 is 28d of hollow sections of female mold die 28a, and the interval between crevice 22b of a punch 22 (both mold spacing) reaching the amount (0.2mm) of thickness of the stainless steel board A is said.

[0027] In addition, other composition members are equipped with a punch 22, the press head 23, the inner slider 24, a blank holder 25, the outer slider 26, and the fluid-pressure developmental mechanics 27 like the 1st press machine 20.

[0028] Liquids, such as an oil, are supplied to 28d of hollow sections of female mold 28 from the fluid-pressure developmental mechanics 27, it is the 1st manufacture method which the manufacture method of having these processes also requires for this invention, it fills with the 1st process shown in drawing 6 until an oil level arrives at 28f of upper-limit marginal parts of female mold 28, and the stainless steel board A is laid in 28f of upper-limit marginal parts of the female mold 28 of this state. In this case, it is important to make it the air in a liquid not mix, and, for this reason, it is desirable to apply a liquid to the rear face of the stainless steel board A beforehand so that air may not enter between the oil level of the liquid which were full of, and the stainless steel board A.

[0029] At the 2nd process shown in drawing 7, the blank holder 25 which descends the outer slider 25 and is located in the periphery of a punch 22 is dropped, and the marginal part of the stainless steel board A laid in female mold 28 is pinched with 28f of upper-limit marginal parts of female mold 28. The compression pressures to the stainless steel board A in this time are about 140 kgf/cm².

[0030] At the 3rd process shown in drawing 8, where 28d of hollow sections of female mold 28 and the fluid pressure between the stainless steel boards A are maintained to high pressure, the inner slider 24 is descended, a punch 22 is dropped, and a punch 22 is inserted in 28d of hollow sections of female mold 28 from a bottom dead point to specified quantity this side. The fluid pressure in this case is maintained to about two 2000 kgf/cm by the fluid-pressure developmental mechanics 27. As for insertion in 28d of hollow sections of the female mold 28 of the punch 22 in this time, it is desirable that both the mold spacing is about 1.2mm. Thereby, much heights 12a shown in this drawing (b) is fabricated by the stainless steel board A which is a molding material.

[0031] At the 4th process shown in drawing 9, where 28d of hollow sections of female mold 28 and the fluid pressure between the stainless steel boards A are extracted, specified quantity elevation of the ejector-half 28b is carried out, it becomes depressed and the specified quantity protrusion of the crowning of each pillar-shaped section 28c of ejector-half 28b is carried out

from 28d of sections. As for the relative insertion to 28d of hollow sections of the female mold 28 of the punch 22 in this time, it is desirable that both the mold spacing is about 0.5mm. Although the fluid pressure in this case is about 0, the stainless steel board A which is a molding material is pressed by both the molds 28 and 22 after the liquid has intervened among crevice 22b of the crowning of pillar-shaped section 28c of female mold 28, and a punch 22, and, thereby, much heights 12b shown in this drawing (b) is fabricated by the stainless steel board A which is a molding material. Heights 12b is the thing of the configuration which heights 12a shown in (b) of drawing 8 was again pressed, and approximates to each heights 12 of the light-gage metal plate 10 extremely.

[0032] At the 5th process shown in drawing 10, where 28d of hollow sections of female mold 28 and the liquid between the stainless steel boards A are drained, the inner slider 24 is descended, a punch 22 is dropped, and a punch 22 is inserted in 28d of hollow sections of female mold 28 to a bottom dead point. Heights 12b currently formed in the stainless steel board A which is a molding material by this is pressed again, and deforms into the heights 12 shown in this drawing (b). That is, much heights 12 are formed in the stainless steel board A which is a molding material, and the light-gage metal plate 10 is completed.

[0033] Also in the manufacture method concerned, since it presses gradually between **** of both the molds 28 and 22 further from it being what a fluid pressure is made to intervene and is pressed between **** of both the molds 28 and 22 where a fluid pressure is changed, whose generating in a crack, curvature, and the shoulder and base of each heights can be prevented. That is, according to the manufacture method concerned, the light-gage metal plate 10 can be manufactured without making the stainless steel board A which is a molding material produce a crack and curvature, and the shoulder or base of each heights 12 are not produced for whom in this case.

[0034] While reaching 1st press machine 20 and making into a punch female mold 21 and 28 in 2nd press machine 20A adopted by the 1st manufacture method concerning this invention, a punch 22 can be changed into female mold, and the 2nd manufacture method concerning this invention can consist of manufacture methods concerning this invention. In this case, since a liquid will be supplied to the hollow section of a punch, and the space section between molding materials, in case it will supply a liquid to this space section where a molding material is pinched with vertical both molds and supplies a liquid, it needs the air vent from this space section.

[Translation done.]